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By
Hamlin L. Williston and Ike W. Rawls

SOUTHERN FOREST EXPERIMENT STATION
Chas. A. Connaughton, Director
New Orleans, La.

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Southern Forest Experiment Station

How much yearly income can a farmer in south Arkansas or northern Louisiana expect from his forest? In 1937 the Crossett Branch of the Southern Forest Experiment Station started a farm woodland study to find out. The foresters at this Branch thought that a well-stocked farm forest could produce a crop every year, just as a cotton field or potato patch does. The trouble was that most farm forests in the area were--and still are--badly understocked. That raised a second question: What is the best way of developing a good forest from a run-down stand?

Two areas were selected for study. One well-stocked 40-acre pine-hardwood forest (Compartment 51 of the Crossett Experimental Forest) was used to determine the possible returns from farm woodlands once the stands had been built up. Another area of 34 acres (Compartment 56) had a light stand of loblolly and shortleaf pine. The pines were of low quality, though, and a very large number of nearly worthless hardwoods were competing with them.

Both forests have now been under management for 10 years. The returns from the better tract have been reported annually by this Station. This paper describes the results on the "poor" forest.

What the Understocked Forest Was Like in 1937

The "poor" area had been heavily cut over prior to 1937 and, like so many farm woodlands in the area, had been burned by many uncontrolled fires. As a result, the number and quality of the pine trees had been quite seriously reduced, and low-grade hardwoods were monopolizing nearly 50 percent of the growing space. The merchantable stand per acre was about 1,895 board feet (Doyle rule) of pine and 117 board feet of hardwood sawlogs, 5.4 cords of pine pulpwood, and 2.6 cords of hardwood chemical wood and fuelwood. (Chemical wood is used in the production of charcoal, acetic acid, and methanol.)

Table 1 shows the number of merchantable trees present in 1937. The table does not include the large but worthless hardwoods nor show that the ground was covered with a dense growth of low-grade hardwoods below 5 inches in diameter at breast height.

Table 1.--Number of merchantable trees per acre

Species	1937 inventory	Cut 1939-46	1946 inventory
Pine			
Cordwood size 1/	68	15	67
Sawlog size 2/	19	8	20
Red and white oak			
Cordwood size 1/	38	50	4
Sawlog size 2/	2	2	0
Other salable hardwoods			
Cordwood size 1/	15	22	6
Sawlog size 2/	2	1	0
All trees			
Cordwood size 1/	121	87	77
Sawlog size 2/	23	11	20

1/ Pines 3.6 to 11.5 inches in diameter at breast height (d.b.h.), and/or hardwoods 4.6 to 11.5 inches d.b.h.
2/ Trees 11.6 inches and over, d.b.h.

Building Up the Forest

Stocking on this forest was thus quite low in 1937. Nevertheless, annual cuts were prescribed to see if the stand could not pay its way while being built up in productiveness. Such yearly harvests would place the stand in good growing condition at an early date. They would also give a cash income each year. Annual cuts would also permit prompt thinning of dense groups of trees and the removal of the large crop of small, low-grade hardwoods as soon as they became merchantable.

Although records were begun in 1937, the first cut was not made until 1939. The eighth cut was made in 1946. In these eight cuts, 15 of the original 68 cordwood-size pines per acre and 8 of the 19 pines per acre of sawlog size (11.6 inches d.b.h. or over) were cut and marketed. A few of these trees were mature, some were in groups that needed thinning, and others were too limby ever to produce good-quality saw timber. The 1946 inventory showed that many trees of cordwood size

in 1937 had grown into sawlog size during the 1937-46 period. Likewise, some trees below cordwood size in 1937 grew into this size by 1946. In fact, this growth in size has been great enough so that today the stand has as many pine trees of cordwood size and larger as it did in 1937, even though a good many were cut between 1937 and 1946. The size of the average saw-timber tree has also increased considerably.

When the study began, the stand contained 57 merchantable hardwoods per acre of cordwood size or larger. More than that number were cut by 1946. In addition, the large, unmerchantable hardwoods--about 1 per acre--were girdled at a cost of a few cents apiece.

Although the pine stand is still very light, it has grown, during the ten growing seasons since 1937, at the rate of 168 board feet per acre per year (Table 2). Furthermore, the volume of pine sawlogs present after the eighth cut was 3,022 board feet per acre--1,127 more than before the first cut was made. During these 10 years

Table 2.--Wood volume growth per acre

(Board-foot measurements are in Doyle rule)

Item	Pine		Red and white oak		Other salable hardwoods		All trees	
	Cordwood size 1/	Sawlog size 2/	Cordwood size 1/	Sawlog size 2/	Cordwood size 1/	Sawlog size 2/	Cordwood size 1/	Sawlog size 2/
	Cords	Bd.ft.	Cords	Bd.ft.	Cords	Bd.ft.	Cords	Bd.ft.
1937 inventory	5.43	1,895	2.11	63	0.52	54	8.06	2,012
Cut, 1939 to 1946	3.83	551	3.74	3/20	.92	3/17	8.49	588
1946 inventory	6.05	3,022	.19	0	.15	0	6.39	3,022
10-year growth	4.45	1,678	1.82	3/-43	.55	3/-37	6.82	1,598
Annual growth	.44	168	.18	-4	.06	-4	.68	160

1/ Pines 3.6 to 11.5 inches d.b.h., and/or hardwoods 4.6 to 11.5 inches d.b.h.

2/ Pines and hardwoods 11.6 inches or over, d.b.h.

3/ Besides those actually made into sawlogs, sawlog-size hardwoods were also cut into chemical wood. Hardwoods so used are listed as negative board-foot growth for the 10-year period.

the volume of the average pine saw-timber tree increased from about 100 board feet to about 150 board feet. The stand also contains 6 cords of pine pulpwood per acre and a very large number of young pine of near-pulpwood size.

Fire was kept completely out of the forest.

Today, as a result of the cutting practices and the protection from fire, an excellent stand of young pine covers nearly the whole 34 acres. (Much of the pine is still under 4 inches in diameter and hence does not show in Table 2.) The forest has been changed from a ragged growth of half pine and half hardwood to a well-stocked stand of nearly pure shortleaf and loblolly pine.

Money in the Pocket

Improvement cuts have thus made a good start toward building up the stand for good growth to come. How about the goal of providing annual income? Table 3 gives the answer. The eight cuts made during the 10-year period removed about 20,000 board feet of sawlogs, 130 cords of pulpwood, 105 cords of chemical wood, 53 cords of fuelwood, and 121 fence posts. On the stump, these products were worth $467. If the

Table 3.--Products harvested between 1937 and 1946

Item	Sawlogs	Pulp-wood	Fuel-wood	Chemical wood	Posts	Total
	Bd. ft. (Doyle)	Cords	Cords	Cords	No.	
Volume cut	19,982	130.27	53.40	105.02	121	...
Per acre	588	3.83	1.57	3.09	3.56	...
			Value (dollars) on stump			
Total cut	216.19	152.96	38.86	55.85	3.14	467.00
Per unit	10.82	1.17	.73	.53	.03	...
Per acre	6.36	4.50	1.14	1.64	.09	13.73
Per acre-year	.64	.45	.11	.16	.01	1.37
			Value (dollars) delivered at market			
Total cut	376.90	989.87	541.38	547.38	8.47	2,464.00
Per unit	18.86	7.60	10.14	5.21	.07	...
Per acre	11.09	29.11	15.92	16.10	.25	72.47
Per acre-year	1.11	2.91	1.59	1.61	.02	7.24

owner of the forest had been a farmer and had cut the products and delivered them to market, he would have received $2,464. Table 4 gives the cut of the various products for each year.

Table 4.--Volume of products cut

Year	Sawlogs	Pulp-wood	Fuel-wood	Chemical wood	Posts
	Bd. ft. (Doyle)	Cords	Cords	Cords	No.
1939	0	20.25	4.79	69.67	121
1940	2,996	10.22	0	3.40	0
1941	2,748	10.84	0	0	0
1942	5,314	4.45	9.77	0	0
1943	5,134	21.48	0	0	0
1944	0	60.00	0	31.95	0
1945	0	.36	38.84	0	0
1946	3,790	2.67	0	0	0
Total	19,982	130.27	53.40	105.02	121

Acre for acre, the stumpage return has been $1.37 per year for the 1937-46 period and the market value $7.24 per year. These returns would be more than enough to pay interest and taxes on the land and still leave a small profit.

Perhaps a better measure of the returns to date is the amount of profitable work the forest provided and the returns per hour of labor spent in making the different products. Table 5 shows that it took a total of 3,736 man-hours (467 8-hour man-days) to cut and deliver the sawlogs, pulpwood, chemical wood, fuelwood, and posts. For the eight cuts, this is an average of about 58 days of work per year for one man.

For this work (without allowing for what the timber would have sold for on the stump) an owner would have grossed about 66 cents per hour of labor. After deducting for taxes, fire protection, interest,[1/] and for out-of-pocket expenses connected with harvesting, but not for stumpage value, he would have averaged 49 cents per hour of labor, net.

Table 5 shows that the returns per hour of labor were greatest for sawlogs and pulpwood, which are in general cut from the best trees, and lowest for chemical wood and fuelwood, the products of the low-quality trees. However, it is cutting out the low-quality, crowded, or diseased trees that gives the good trees room to grow and provides space for more pine seedlings to come in. The fact that undesirable or surplus trees could be sold for chemical wood and fuelwood added just that much more to the profits. As the forest fills up with good trees that can make high-priced products, the returns per man-hour will increase. In fact, the grade of the products improved so much

1/ Four percent interest on an assumed value (1937) of $15 per acre.

from cut to cut that the average net returns per hour for the last few years were considerably above 49 cents. Some of the increase, but not all of it, was due to higher prices.

Table 5.--Total volume and value (delivered at market) of wood cut

Product	Volume harvested	Value (delivered at market)	Labor of harvesting	Returns per man-hour 1/	
				Gross	Net
	Bd. ft. (Doyle)	Dollars	Man-hours	-- Dollars --	
Sawlogs	19,982	376.90	120.30	3.13	2.21
	Cords				
Pulpwood	130.27	989.87	1,315.72	.75	.57
Fuelwood	53.40	541.38	822.37	.66	.50
Chemical wood	105.02	547.38	1,453.48	.38	.28
	Number				
Posts	121	8.47	24.20	.35	.31
Total or average ...		2,464.00	3,736.07	2/.66	2/.49

1/ No allowance for stumpage. In computing net returns, however, deductions were made for taxes, fire protection, interest, and out-of-pocket expenses connected with harvesting.
2/ Weighted average.

Although many landowners do not have unlimited markets for chemical wood and fuelwood, the low-quality trees usually cut for these products need to be eliminated from the stands in order to make room for the more valuable pines to develop. In fact, even if such trees cannot be sold, it is still wise to chop them down or girdle or poison them. The increased growth of good pines will pay for the labor in a few years.

Conclusion

Property owners are often willing to make expensive improvements on their land or buildings because they hope to get their money back later on, in the form of increased income. The "poor" forest is being improved too, but at a profit, not a cost.

How much income will this forest produce when it is fully stocked? That question is being answered by the "good" Farm Forestry Forty at Crossett, which has been growing timber with an average market value of $14.82 per acre per year for the last 9 years. Returns per man-hour of labor for the 1946 harvest--with allowances for taxes, interest, and other expenses, but not for stumpage--were $1.34.

It will take some years to build up the poor stand enough to grow timber at that rate. But in the 10 years that the study has been under way the large numbers of cull and low-quality trees originally present have been eliminated and their places taken by high-value young pines. Over this period about 20,000 board feet of logs, 130 cords of pulpwood, 158 cords of fuelwood and chemical wood, and 121 fence posts have been removed. These products had a total market value of $2,464. This has been more than enough to pay all carrying costs and also to provide the owner with good wages for his work and a small profit besides. Even though a large volume of forest products has been removed, the stand now has 1,127 more board feet of sawlog-size pine and hundreds more young pine per acre than were present in 1937. From these trees increased returns can be expected in the near future.